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QUARTERLY LETTER REPORT NO. 5

6 May 1964

ARPA Order 215, Amend. No. 4

Contractor

LOCKHEED AIRCRAFT CORPORATION FOR  
ITS DIVISION LOCKHEED-CALIFORNIA COMPANY  
Burbank, California

Date of Contract - February 1, 1963

Amount of Contract - \$ 66,273.00

Contract Number - Nonr-3933(00)

Contract Expiration Date - January 31, 1965

Project Scientist - Dr. D. S. Webber

Phone No. Area Code 213

TRiangle 7-2711

Extension 61-257

Title of Work - RESEARCH ON SOLAR MAGNETIC FIELDS

Signed:

*D. S. Webber*

D. S. Webber, Head  
Solar Physics Laboratory

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INTRODUCTION

The program continues to follow closely the outline charted in the previous Quarterly Letter Report (No. 4). An additional step, the construction of "Synoptic Charts", described under accomplishments, has been found advisable; otherwise the procedure is the same. Following the procedure initiated last time, an outline of the steps involved in the study is included in this report, and the numbers of those steps which have been completed are underlined. The project is on schedule and expenditures are within the budget.

SPECIFIC ACCOMPLISHMENTS

During this quarter, 1 February through 30 April, 1964, much of the effort was concentrated on tasks which will lead to statistical results concerning the nature of local magnetic regions. Three major steps to this end were accomplished:

1. The transfer to punched card format of tabulated magnetic region, calcium plage, and sunspot data, begun last quarter, was completed.
2. The product of the first computer program was obtained. This program gives a tabulation of all magnetic regions and their corresponding calcium plages within limits specified as:  
 $\pm 10$  degrees in latitude and  $\pm 13$  degrees in longitude.
3. Synoptic charts were constructed from the isogauss maps. Each chart is a composite of the magnetic characteristics of the sun for one revolution or 27 days. It is essentially

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a Mercator projection of the sun, with the magnetic fields observed in the vicinity of the central meridian plotted for each day. These charts will be used in checking for cases in which the programmed identification of corresponding magnetic regions and calcium plages gives ambiguous results. In addition, the synoptic charts will facilitate the identification of regions which are physically the same, but identified by different region numbers in successive disk passages. Also, gross characteristics of magnetic field structure, not necessarily associated with the local magnetic regions, if these exist, will be more readily identified and studied.

As part of the study of unipolar magnetic fields, the Mount Wilson H-alpha images of the sun taken on glass plates for the period August 1959 through December 1962, were reproduced on 35 mm. film. The major benefit to be derived from the H-alpha images in this study is related to the filaments readily seen on these images. Previous work by Dr. Robert Howard indicates that extensive, long-lived filaments often separate areas of opposite polarity. The stages at which these extensive filaments develop in the evolution of magnetic regions may help in defining more precisely what should be called a unipolar magnetic region. At present we have only a general definition, that is, a unipolar magnetic region is any area of single polarity which does not appear to be related to other nearby regions.

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FUTURE PLANS

A series of computer programs have been planned which will eventually give information about the evolution of local magnetic regions. The programs to be written and run during the next quarter are expected to yield:

1. Identification of successive disk passages of regions.
2. Assignment of a magnetic region series number to successive disk passages of the same magnetic region.
3. Identification of sunspot groups by magnetic region series number.
4. Identification of Flares by magnetic region series number.

Because of changes which occur during the 13 days in which regions are on the invisible hemisphere of the sun, the identification of successive disk passages of the same region is not always possible by machine methods, and judgment of the investigator must be used. Also, because of the different methods used in identifying and classifying magnetic regions, calcium plages and sunspot groups, the correspondence between these regions, plages and sunspots cannot always be determined correctly by a computer program. Consequently, after each programmed step, manual checks and corrections will be made. These requirements do not alter the time schedule since they were known and considered at the outset of this project.

A deviation from plans as reported in Quarterly Letter Report No. 4 was made in order to facilitate these manual operations between the programmed



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steps. Synoptic charts were constructed before advancing to the next computer program. This change was made to expedite the handling of data and does not constitute a retardation in the work schedule.

PROBLEM AREAS

At this time, no significant problem areas are anticipated.

# MAGNETIC FIELD STUDY

Contract Number Nonr 3933( 00)

## Input Data

Magnetograms - Mt. Wilson  
Calcium Spectroheliograms - Mt. Wilson  
H $\alpha$  Images - Lockheed  
Tabulated Ca Flare, Sunspot Data - Published by NBS in CRPL - B Series  
Tabulated Flare Data - NBS

## 1. Conversion of Magnetograms into Iso Gauss Maps Total 703

### 2. Computer Analysis

- 2.1 Identify regions & tabulate parameters: Area, Position, etc. (2028 regions)
  - 2.2 Transfer data to punched cards
    - 2.2.1 Magnetic regions
    - 2.2.2 Calcium plages
    - 2.2.3 Sunspots
  - 2.3 Purchase flare cards - NBS
  - 2.4 Machine Program
    - 2.4.1 Construct flow charts
    - 2.4.2 Work with programmer
    - 2.4.3 Check output
  - 2.5 Write results

### 3. Chromosphere Study

- 3.1 Test methods for direct comparison of isogauss maps Ca & H $\gamma$  spectroheliograms
  - 3.2 Approach selected
    - 3.2.1 H $\alpha$  off-band drawings of plage structure
    - 3.2.2 Match H $\alpha$  off-band drawings with isogauss maps
    - 3.2.3 Draw flare maps reduced to isogauss map time
    - 3.2.4 Measure parameters for flares, filaments, etc.
    - 3.2.5 Analyze
  - 3.3 Write results

### 4. Unipolar Magnetic Fields

- 4.1 Preliminary study
  - 4.2 Extended study
    - 4.2.1 Reproduce Ca & H $\alpha$  plates on 35-mm film
    - 4.2.2 Identify unipolar regions on Ca images
    - 4.2.3 Record History
      - Intensity
      - Position
      - Other Characteristics
    - 4.2.4 Analyze
    - 4.2.5 Compare with occurrence of geomagnetic storms
  - 4.3 Write results

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